B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E.   **Semester: IV**
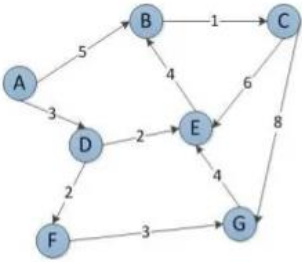
Branch: Artificial Intelligence and Machine Learning   **Duration: 3 hrs.**
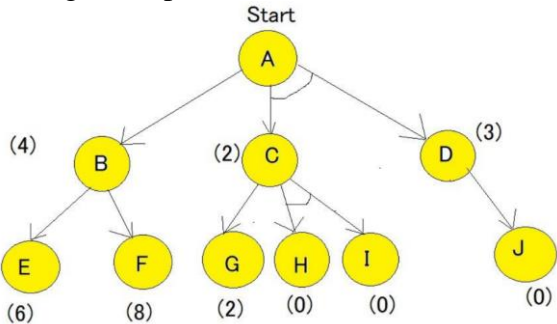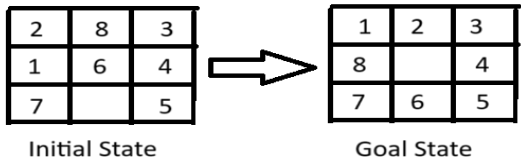
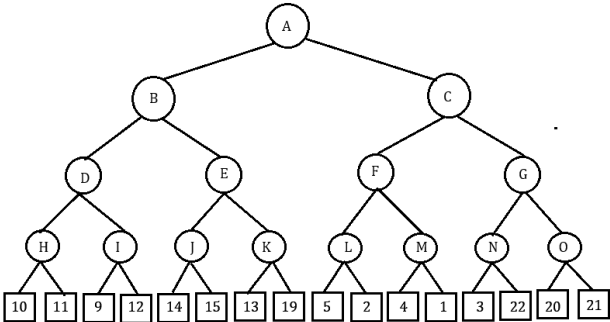**Course Code: 24AM4PCIAI**   **Max Marks: 100**

Course: Introduction to Artificial Intelligence

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	**CO**	**PO**	**Marks**
1	a)		Analyze the structure of an intelligent agent. How does each component of the agent contribute to intelligent behavior? Illustrate with a diagram and example.	CO2	PO1	**6**
	b)		Given an AI agent designed to play chess, analyze what kind of agent architecture is appropriate. Justify your choice based on environment characteristics (observable, deterministic, episodic, etc.).	CO2	PO1	**6**
	c)		A hospital's emergency response team needs to dispatch an ambulance to reach a patient as quickly as possible. The city consists of multiple intersections connected by roads, each with a different travel time due to traffic conditions. Given a starting location A (hospital) and a destination G (patient's location), design an algorithm using Uniform Cost Search (UCS) to determine the fastest route with the least travel time. Find the minimum time path from A to G, considering different routes and traffic delays.	CO2	PO1	**8**
			OR			
2	a)		Differentiate between Depth First Search (DFS) and Breadth First Search (BFS) and show how their traversal orders change on an example graph?	CO1	PO1	**6**
	b)		A self-driving car must choose among multiple possible routes to reach its destination. Each route varies its utilities in terms of traffic, travel time, fuel consumption, and road safety. Identify the	CO1	PO1	**6**

			type of agent best suited for this scenario. Elaborate on the model with a neat diagram.			
		c)	Formulate a production system to solve the classic Water Jug Problem, where a 4-liter jug and a 3-liter jug are used to measure exactly 2 liters of water. Provide the solution by listing appropriate production rules, and represent the sequence of operations in the form of a tree.	*CO2*	*PO1*	**8**
			UNIT - II			
3	a)		How can the Generate and Test approach be applied to solve a real-world optimization problem, and why is it considered a heuristic method? Justify your answer with an algorithm.	*CO1*	*PO1*	**6**
	b)		i. Illustrate AND-OR graph with an example. ii. Apply the AO* algorithm to determine the optimal solution path in the given AND-OR graph. Clearly show the step-by-step process, including cost updates and node selection. 	*CO2*	*PO1*	**6**
	c)		Solve the following cryptarithmetic equation, where each letter represents a unique digit from 0 to 9 CROSS + ROADS = DANGER	*CO2*	*PO1*	**8**
			OR			
4	a)		Analyze the inherent limitations of the Hill Climbing algorithm when applied to informed search strategies	*CO1*	*PO1*	**6**
	b)		Illustrate Constraint Satisfaction Problem and its components with an example.	*CO2*	*PO1*	**6**
	c)		For the given 8 puzzle problem propose best heuristic function to search the goal state. Find the most cost-effective path to reach the final state using A* algorithm. 	*CO2*	*PO1*	**8**
			UNIT - III			
5	a)		Consider the fact: "If the room is dark and the light switch is on, then the light will turn on." Let: • P= The room is dark • Q = The light switch is on • R = The light will turn on	*CO2*	*PO1*	**6**

				CO1	PO1	6
		Formalize the sentence in Proposition Logic and write it in Inverse, Converse and Contrapositive form.				
	b)	Convert the following First-Order Logic formulas into clear English sentences.		CO1	PO1	6

    i. $\forall x\ (Student(x) \rightarrow \exists y\ (Book(y) \land Reads(x,y)))$
    ii. $\exists x\ (Teacher(x) \land \forall y\ (Student(y) \rightarrow Teaches(x,y)))$
    iii. $\forall x\ (Human(x) \rightarrow Mortal(x))$
    iv. $\forall x \exists y\ (Loves(x,y) \land Loves(y,x))$
    v. $\exists x\ (Cat(x) \land \neg Friendly(x))$
    vi. $\forall x\ (student(x) \rightarrow (walk\ (x) \lor talk\ (x)))$

	c)	Consider the premises of first order logic and prove the conclusion using resolution algorithm.	CO2	PO1	8

- Anyone whom Mary loves is a football star.
- Any student who does not pass does not play.
- John is a student.
- Any student who does not study does not pass.
- Anyone who does not play is not a football star.

(Conclusion) If John does not study, then Mary does not love John.

OR

6	a)	i. Explain Unification in knowledge representation with an example.
		ii. Give the required conditions for Unification
		iii. Given the following pairs of expressions, determine whether they can be unified. If so, provide the most general unifier (MGU). If not, explain why unification fails.
		   1. Knows(John, x) and Knows(y, Bill)
		   2. (b) Loves(x, x) and Loves(John, Mary)
			CO1	PO1	6

	b)	i. List the drawbacks of Propositional Logic. ii. Explain the Syntax and Semantics in First order Logic.	CO1	PO1	6
	c)	i. Formulate the steps to convert First Order Logic to Clausal Form. ii. Convert the given sentence to Clausal form: "Anything anyone eats and not killed is food"	CO2	PO1	8

UNIT - IV

7	a)	i. Define acting under uncertainty in Artificial Intelligence. ii. Provide ways to deal with uncertainty. iii. Consider a weather forecasting system that tracks three binary variables:	CO1	PO1	10

- Rain (R): Whether it rains or not
- Cold (C): Whether it's cold or not
- Wind (W): Whether it's windy or not

The joint probability distribution for these weather conditions is given in the following table, where ~R means "no rain", ~C means "not cold", and ~W means "not windy"

	Rain		~Rain	
	Wind	~Wind	Wind	~Wind
Cold	0.108	o.o12	0.072	0.108
~Cold	0.016	0.084	0.144	0.456

Using the table, calculate the joint probabilites of :
- P(Rain, Cold, wind)

			• P(~Rain, ~Wind, ~Cold) • P(Cold, Wind)			
		b)	i. Explain Bayes' Rule. ii. Discuss its significance in probability theory. iii. Suppose 20% of emails are spam. The word "win" appears in 60% of spam emails and 5% of non-spam emails. If an email contains the word "win", Apply Bayes rule to calculate the probability that it is spam.	CO2	PO1	**10**
			OR			
	8	a)	Consider the given tree and Perform the following: i. Apply Minimax and find the optimal move for the MAX player at the root. ii. Repeat using Alpha-Beta pruning and show the pruned branches.	CO2	PO1	**10**
		b)	Prove the following using Forward chaining: "As per the law, it is a crime for an American to sell weapons to hostile nations. Country E, an enemy of America, has some missiles, and all the missiles were sold to it by Robert, who is an American citizen." Prove that "Robert s criminal."	CO2	PO1	**10**
			UNIT - V			
	9	a)	A logistics officer is trying to decide how to allocate limited transportation resources during a disaster relief operation. She must choose between using a conventional rule-based software or an AI-powered expert system that can reason under uncertainty. In the context of the above scenario, explain how an expert system differs from a conventional system in terms of decision-making, adaptability, and knowledge handling.	CO2	PO1	**10**
		b)	Rahul is a healthcare IT specialist tasked with implementing an expert system for diagnosing bacterial infections. i. Identify a suitable Expert System and discuss its architecture. ii. Outline the strengths and limitations of the Expert System for the given scenario.	CO2	PO1	**10**
			OR			
	10	a)	You are assigned to design an expert system to assist farmers in diagnosing crop diseases based on symptoms, environmental conditions, and soil quality. Identify and explain how each component of an expert system would be applied to build the system with a neat diagram.	CO1	PO1	**10**
		b)	Illustrate Diagnostic Assistance Reference Tool (DART) Expert System.	CO1	PO1	**10**

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